International Journal of Mental Health and Addiction
https://doi.org/10.1007/s11469-023-01052-8

CLINICAL CASE STUDIES

The Feasibility of Goal Management Training to Address Cognitive Impairment in an Outpatient Alcohol Treatment Population: Findings from a Novel Case Series

Lauren A. Monds[1,2,3] · Amy Crowe[1] · Maria Bravo[1] · Nicole Ridley[1] · David Newcombe[4] · Rhys Mantell[5] · Nicholas Lintzeris[1,2] · Adrienne Withall[5]

Accepted: 7 April 2023

Abstract
People with alcohol use disorder (AUD) exhibit high rates of comorbidity with cognitive deficits, particularly for executive function (EF). Cognitive impairment has been related to poorer outcomes in substance use treatment. Goal management training (GMT), a structured, therapist-led manualised intervention targeting EF, has demonstrated positive preliminary results in substance use disorder (SUD) treatment programs.. However, these studies have had strict exclusion criteria (e.g. excluding clients with mental health disorders), and the feasibility of running such a program in a broader SUD outpatient setting is unclear. The primary aim of this study was to determine the outcomes and feasibility of a cognitive remediation intervention at an outpatient alcohol treatment service in Sydney, Australia. Clients were referred to the study based on risk of cognitive deficits (as indicated by objective cognitive impairment on a screening tool or relevant collateral clinical information). Eligibility criteria included diagnosis of a current alcohol use disorder and abstinence for 2 or more weeks. The intervention consisted of 9 weekly GMT sessions. Out of 34 clients referred, 11 were eligible to participate, and of these, five were allocated to the intervention group and two to a waitlist control group. Due to poor recruitment, statistical analyses between groups were not possible; instead, this study presents a case series of the five clients recruited to the 9-week group intervention using GMT. Clients engaged in the intervention presented with a range of deficits in their cognitive functioning at baseline. Despite positive comments from participants regarding the intervention, there was a high level of attrition; while four clients (80%) completed at least four sessions, only one participant remained until the end of the nine-session program. In its current form, this program is not suitable for this cohort in the outpatient setting. Suggestions are made for tailoring GMT and other approaches to increase engagement and retention in future interventions.

Keywords Alcohol use disorder · Cognitive remediation · Executive function · Goal management training

✉ Lauren A. Monds
lauren.monds@sydney.edu.au

Extended author information available on the last page of the article

Published online: 28 April 2023

Alcohol use disorder (AUD) can lead to cognitive impairments in 50–80% of affected individuals (Bates et al., 2002; Hayes et al., 2016). These deficits may persist even after periods of acute intoxication and withdrawal (Vik et al., 2004) and up to 6 months into abstinence (Fernandez-Serrano et al., 2011). As a result, cognitive issues can significantly affect people in recovery from alcohol use and are a common cause of treatment drop-out (Brorson et al., 2013). Individuals with comorbid substance use and cognitive deficits also experience poorer treatment retention rates (Bates et al., 2006; Copersino et al., 2012; Shulman et al., 2018) and lower self-efficacy (Bates et al., 2006). Disruptions to cognitive processes can significantly impact daily functioning and interfere with the effectiveness of typical treatment modalities for substance dependence, such as learning new coping skills (Kiluk et al., 2011). Given these challenges, it is crucial to develop interventions targeted at remediating underlying cognitive functions. Doing so may help decrease substance use and improve re-entry into the community (Monds et al., 2021; Sullivan et al., 2021). One component identified to be particularly sensitive to alcohol use is executive function (EF; Harper, 1998, 2007; Perry, 2016; Sullivan et al., 2000). EF includes key components of working memory, inhibition and flexibility, which facilitate the execution of more complex processes such as planning and reasoning (Barkley, 2001; Miyake et al., 2000; Suchy, 2009). EF is thought to be associated with the development and maintenance of new behaviours (Perry, 2016; Vik et al., 2004). Deficits in EF can hinder an individual's ability to actively participate in and gain benefits from treatment for AUD. Such deficits have also been linked to poorer treatment outcomes (Domínguez-Salas et al., 2016).

One potential approach for cognitive remediation in an AUD population is goal management training (GMT), a structured, therapist-led manualised intervention targeting EF (Levine et al., 2000; Robertson et al., 2005; Stamenova & Levine, 2019). This is typically delivered in a group format over 9 weekly 2-h sessions that includes psychoeducation, group brain-storming activities and hands-on activities focused on building cognitive awareness, strategies and confidence (Levine et al., 2000). GMT has demonstrated positive preliminary findings when delivered in substance use disorder (SUD) residential and outpatient programs (Alfonso et al., 2011; Valls-Serrano et al., 2016). In residential settings, GMT was associated with reductions in impulsivity and time taken to plan tasks and an increase in working memory (Valls-Serrano et al., 2016). In outpatient settings, GMT was associated with improvements in inhibition and working memory (Alfonso et al., 2011). However, there remain gaps in the literature regarding the efficacy of GMT with respect to program adherence and client retention in an alcohol outpatient setting. For instance, in Alfonso et al. (2011), people with comorbid DSM-IV Axis 1 disorders were excluded. Given psychiatric comorbidity is common in alcohol treatment populations (García-Carretero et al., 2017), it was of interest to pilot this program with more naturalistic inclusion criteria. In addition, cognitive remediation programs have been more extensively studied in inpatient programs (Marceau et al., 2017) where factors such as current substance use and travel to the treatment site are not barriers to engagement.

The primary aim of this study was to recruit participants to undertake GMT in a specialist Alcohol and Other Drug (AoD) outpatient setting and determine (1) the outcomes on cognition, using a neuropsychological battery and waitlist control design, and (2) how feasible it would be in terms of service engagement. Feasibility was operationalised as ability to meet the target recruitment rate (detailed below), with at least 80% attendance of the GMT sessions. We focused specifically on people with AUD in the first instance, as a relatively high proportion of this cohort is reported to have less polysubstance use than other drug groups (Kedia et al., 2007). The latter eligibility criterion was proposed to minimise the variation between clients, which would aid in drawing conclusions about the

effectiveness of GMT in enhancing executive function. This aligns with the original goal of recruiting sufficient participants to conduct statistical analyses on neuropsychological baseline and follow-up measures. The initial aim was to analyse baseline and follow-up neuropsychological data for up to 20 participants in a waitlist control design group GMT intervention. The amended aim, due to low recruitment, was to detail a case series of five clients recruited to a once-per-week group GMT program for 9 weeks. This case series aims to examine the cognitive profiles of individuals in this group, as well as their level of engagement in the intervention and any factors that may facilitate or hinder their adherence to the treatment.

Methods

Participants

All components of the study were ethically approved by New South Wales (NSW) Health Research Ethics Committee. Participants were recruited between February and May 2018 from an AoD outpatient setting in Sydney, Australia. Participants were required to be between 18 years of age and the maximum age of 65 years to reduce confounds of natural cognitive decline associated with normal ageing (Harada, Natelson Love & Triebel, 2013). The initial referral eligibility criteria required clinical indication of the risk of cognitive deficits. This was determined by scoring below the cutoff point of <26 on the Montreal Cognitive Assessment (MoCA), the screening tool used to assess cognition at the service, or relevant collateral clinical information identified by senior clinicians or addiction medicine specialists. This included factors such as history of emergency department presentation related to alcohol use, risk of Wernicke's or relevant history of clinical presentation at the service, e.g. severe disorganisation and memory concerns. To determine the eligibility for the study, participants underwent a brief telephone screening conducted by a researcher or clinician who was part of the research team. Participants were required to meet the International Classification of Diseases, Tenth Revision (ICD10; WHO, 2010) criteria for SUD—alcohol; have been abstinent from alcohol for 2 or more weeks; have availability to attend the intervention weekly at the centre; and have consent to completing a breath test analysis for alcohol and a saliva swab for the presence of drugs prior to completing baseline and follow-up neuropsychological testing. They also needed to have adequate English language skills to give valid consent. Exclusion criteria included recent initiation (within preceding month) of psychotropic medication (e.g. antidepressants, antipsychotics, benzodiazepines); any other substance dependence (other than nicotine or caffeine); unable to participate in study procedures due to impending incarceration or travel during the trial; lack of stable housing and/or contact phone number; and participants who were participating in any other clinical study were also excluded.

In total, 34 individuals were referred to participate in the study. Of the 34, nine were lost to follow-up, three reported a change of interest in participating, two were not interested due to length of program, two had competing treatment priorities, three were unable to attend due to employment/training (two were recruited to control), nine were excluded due to current substance use, and one was excluded due to being >65 years of age. In total, 11 individuals were invited to take part in the study, three were lost to follow-up and one was no longer interested due to length. The final group that was

included in the study consisted of five individuals who received the intervention and two individuals who were part of the waitlist control group.

Cognitive Measures

The measures are validated neuropsychological tests (Strauss et al., 2006) chosen to capture key domains of cognitive functioning known to be impacted in AUD, while maximising brevity. The method from the Ridley et al. (2018) paper was used to establish impairment from performance on the neuropsychological test battery. This method was chosen to ensure consistency, as it aligns with the criteria that are typically used for research within the service where the current study was conducted.

The Test of Premorbid Functioning (TOPF) The participant read a list of words aloud that are phonetically atypical and cannot be correctly pronounced by sounding them out (Wechsler, 2011). This is commonly used as a measure of premorbid intelligence.

Impairment threshold: N/A, used to establish premorbid intelligence.

The Montreal Cognitive Assessment (MoCA) Form A was used to screen for the study and Form B for the baseline cognitive assessment (Nasreddine et al., 2005). A score of < 26 (included education adjustment) was classified as impaired on initial screening.

Executive Functioning Measures

WAIS-IV: Digits Backwards This subtest of the WAIS-IV (Wechsler, 2008) assesses working memory. Participants are required to repeat a sequence of numbers verbally in reverse order to their presentation.

D-KEFS: Color-Word Interference (Inhibition Trial) The Color-Word Interference task was used to measure inhibitory control with conditions 2 and 3 administered (Delis et al., 2001).

D-KEFS: Design Fluency This was used to capture non-verbal fluency where participants are required to generate as many unique designs as possible in 60 s (Delis et al., 2001).

D-KEFS: Verbal Fluency This was a letter fluency task, where participants are presented with target letters F, A and S and are required to recount as many words as they can think of that begin with the letter within 60 s (Delis et al., 2001).

D-KEFS: Trail-Making (Switching Trial) This was used to assess mental flexibility; participants are required to switch between connecting ascending numbers and ordering letters of the alphabet (Delis et al., 2001).

Impairment threshold for all executive functioning measures: < 1.5 standard deviations below age-adjusted score; impairment required on two tasks to be classified as impaired in executive functioning domain.

General Cognitive Functioning Measures

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) This is administered as a screening measure of cognitive functioning in adults with suspected impairment. The measure contains tasks evaluating immediate memory, visuospatial/constructional, language, attention and delayed memory domains (Randolph et al., 1998). Form B was used.

Impairment threshold for general cognitive measure: < 1.5 standard deviations below age-adjusted score for each summary domain (immediate memory, visuospatial/constructional, language, attention, delayed memory).

Intervention—Goal Management Training (GMT) (Robertson, 1996; Levine et al., 2000, 2007) GMT is a manualised intervention developed for individuals with deficits in EF. The intervention consists of 9 modules and can be delivered in either individual or group format. The intervention was delivered at the service in a group format. Participants engaged in weekly 2-h sessions, which were led by two facilitators who were psychologists. The facilitators led participants through the components of the intervention including psychoeducation, group brain-storming activities, individual pen and paper activities and hands-on activities.

Procedure

Recruitment was via self-referrals from poster advertising around the service and through the service's existing internal referral process. Clinical staff at the service discussed the research project with clients and provided the research team with contact details of consenting potential participants. Potential participants were contacted to complete the brief telephone screen to determine eligibility as described above.

All participants screened as eligible were scheduled to attend a face-to-face appointment to complete the baseline testing prior to intervention. Prior to all testing, following written consent, participants underwent breath test analysis for alcohol intoxication and saliva analysis for the presence of illicit substances. Any positive returns required that the participant attends another day and be able to return a negative screen to complete testing. A comprehensive neuropsychological test battery was used to establish profiles of objective cognitive deficits. Interviews took approximately 2 h and breaks were provided as necessary to mitigate fatigue. The neuropsychological test battery order was selected to provide an appropriate time delay between similar tasks to avoid contamination, e.g. visuospatial tasks being confused on MoCA and RBANS. Testing was completed by the clinical neuropsychologist and appropriately trained researchers. Participants were reimbursed with a $40 groceries gift card for their time.

Results

Given low recruitment and high attrition rates, statistical analyses were not able to be performed within (i.e. before and after) or between (i.e. intervention vs control) groups for the neuropsychological results. Instead, we adopted a case series methodology. A summary is provided in Table 1 for the five participants who commenced the GMT intervention. There

Table 1 Case series summary of the five participants who enrolled in the GMT treatment program

	Participant 1, female age 30	Participant 2, male age 42	Participant 3, male age 50	Participant 4, female age 55	Participant 5, male age 60
Educational background	Finished year 10 + TAFE	Finished year 9 + 1 year of TAFE	Finished year 10 + TAFE	Finished year 10 + 1 year of training	Finished 3 years university education
AXIS I (DSM-IV)	History of anxiety and depression	History of anxiety and depression	NA	Severe depression	NA
Substance use history (duration of use)	EtOH, 5 yrs Cocaine, 7 yrs Meth, 6 yrs BZD, 3 yrs	EtOH, 30 yrs THC and Meth, 10 yrs Cocaine, 5 yrs Heroin, 5 yrs	EtOH and THC, 35 yrs Cocaine, 3 yrs LSD, 10 yrs	EtOH and THC, 35 yrs Cocaine, 5 yrs Heroin, 5 months	EtOH, 42 yrs BZD, 3 weeks
Impairment	Impairment on MocA and all domains except language	Impaired MoCA score and subjective reports of impairment but scored within normal range for rest	Impairment on MoCA and 1 EF task	Impairment on MoCA and the visuospatial/constructional domain	Impairment on MoCA executive, immediate memory, visuospatial/construction
Outcome	Required additional support during intervention; completed 6/9	Completed 9/9 (last 3 sessions 1:1); subjective reports of improvement	Completed 5/9, ceased due to work commitments. Reported improvement	Completed 1/9; did not provide feedback	Completed 4/9 due to back injury; reported improved memory

NB: *BZD*, benzodiazepine; *EtOH*, alcohol; *Meth*, methamphetamine; *MoCA*, Montreal Cognitive Assessment; *TAFE*, technical and further education; *THC*, cannabis

was a high drop-out rate, despite participants providing positive anecdotal feedback about the content and skills learnt. Of the five participants starting the intervention, only one completed all nine sessions. However, four (80%) completed at least the first four sessions. Table 2 provides further details on performance on cognitive measures.

Participant 1: Dropped Out After Session 6

Participant 1 exhibited the most significant level of cognitive impairment: all cognitive domains except for language. She required a higher level of support for instructions during the program and reported difficulty concentrating and understanding tasks. Despite this, she attended the second highest number of sessions, completing sessions 1–6 out of 9.

Participant 2: Completed All 9 Sessions

Despite impairment shown via the MoCA, Participant 2 did not exhibit any impairment of any of the cognitive domains tested. However, he provided subjective reports of difficulty with memory, organising and completing tasks and citing negative affective states (frustration, anxiety etc.) as interfering. He reported benefiting from the mindfulness components of the program, as it allowed him to reduce his arousal level, helping him to utilise skills learnt for remembering and executing tasks. As he completed three sessions in a one-on-one format after all other participants had dropped out, further time was allocated

Table 2 Participant scores on neuropsychological assessment measures

Measure	Group A: initial treatment condition				
	P1	P2	P3	P4	P5
TOPF	93	101	***	94	85
Working memory					
WAIS DSB	4*	12	13	10	5*
D-KEFS switching					
Trails B	0.92	0.70	3.14*	4.72*	14.23*
D-KEFS CWI					
Condition 3	1*	9	13	12	7
D-KEFS fluency					
Verbal fluency	5*	9	***	6	7
Design fluency	5*	8	12	9	10
MoCA Form B	21*	24*	25.83*,**	22*	20*
RBANS					
Immediate memory	65*	81	94	83	57*
Visuospatial	56*	84	87	62	50*
Language	108	85	97	99	85
Attention	43*	100	118	100	97
Delayed memory	44*	78	91	85	81
Total scale	54*	81	95	81	67*

*Indicates impairment. **Indicates MoCA score pro-rated due to failure of recording equipment. ***Score not available due to failure of recording equipment

to individually tailoring strategies. Participant 2 provided positive feedback regarding the program and subjective experience of increased functioning.

Participant 3: Dropped Out After Session 5

Participant 3 exhibited impairment on the MoCA and one task within the EF battery, therefore not meeting criteria for impairment for any of the domains. Recording equipment failures resulted in missing data for the MoCA, TOPF and D-KEFS verbal fluency. A pro-rated MoCA score was able to be computed but the other two domains were unable to be reported. Participant 3 completed sessions 1–5, discontinuing due to returning to employment. After session 3, he reported anecdotally applying the skills introduced in the program to reduce the number of subjective concerns he was having with cognition, e.g. remembering tasks and reading effectively.

Participant 4: Dropped Out After Session 1

Participant 4 exhibited impairment on the MoCA and in the visuospatial/constructional domain. She attended for session 1 of the program and was not interested in completing the rest.

Participant 5: Dropped Out After Session 4

Participant 5 exhibited the second highest level of impairment of the participants. He exhibited impairment on the MoCA and in the EF domain, scoring below the cutoff for two of the EF measures. He also exhibited impairment in the immediate memory and visuospatial/constructional cognition domains. He completed sessions 1–4 and, after sustaining a back injury, was unable to complete the program. He provided positive feedback about the skills taught in the program, especially about being able to learn what individually tailored strategies assisted him to improve his remembering and executing tasks.

Discussion

The aims of the study were to (1) determine the outcomes of GMT in an AoD outpatient setting using a neuropsychological battery and waitlist control design and (2) determine how feasible this intervention is in terms of service engagement. The first aim was unable to be investigated due to poor recruitment and retention across the course of the intervention. This result leads into the second aim, in that the aim of 80% attendance was achieved by only one of the five clients who started the program. This suggests that the traditional manualised 9-week GMT intervention is not suitable for roll-out in an AoD outpatient program.

Several variables may have reduced the eligibility of clients to participate in this program. The exclusion of polysubstance dependence reduced the potential participant pool considerably (9 out of 34, or 26% of potential participants). Although the exclusion criterion was implemented to reduce variability among participants and enable the investigation of cognitive changes throughout the intervention, it should be noted that the study's sample may not be representative of the typical client population in AoD services who often present with

polysubstance issues (Gooden et al., 2021; Lintzeris et al., 2016; Bonfiglio et al., 2022). Further studies should pilot interventions including polysubstance use history.

Furthermore, the content of GMT as an intervention is more specific in nature than, for example, relapse prevention skills groups, which tend to be relevant to larger numbers of clients. The specificity of the content may suggest that it applies to a narrower range of clients, resulting in a smaller proportion of clients being eligible to receive the intervention at any given time. As a result, it may only be feasible to enrol five to seven participants in the intervention simultaneously. Significantly, participants had a range of deficits in cognitive functioning across domains. One participant exhibited no impairment on the neuropsychological assessment, through to another participant exhibiting impairment in all but one cognitive domain. Although this study was provided to target EF, not all participants exhibited a deficit in EF. Only two of the five participants (Participants 1 and 5) met standard criteria for EF impairment—which is an impairment score on more than one task across the EF domain. This finding suggests that a program specifically focusing on EF may also not be the most appropriate for this cohort. On the other hand, it can be argued that measures of EF such as those employed in the current study may not capture the emotional decision-making deficits that are typical in people with AUD; thus, it may be worth considering other EF measures for future studies. Of note, higher impairment was not necessarily associated with shorter length of engagement in the program. Participant 1, exhibiting the highest level of deficit across all domains, completed the second highest number of sessions of all participants. The rate of participant drop-out from modules four to six indicates that the intervention might not be acceptable as a nine-module group format in outpatient drug and alcohol populations. If a similar pattern is observed in subsequent rounds, it may be appropriate to consider a more tailored or abbreviated version of the intervention that is specific to the deficits identified.

Participant feedback also indicated that the group-based format may be unsuitable for such a broad range in cognitive abilities (i.e. participants with severe impairment may require more intensive support). Feedback from Participants 1 and 2 suggests that a one-to-one format might be more acceptable. Participant 1 exhibited higher impairment and reported difficulty in following content as it was paced for the group. Participant 2 provided anecdotal feedback about the positive delivery in 1:1 format for the final three sessions. This finding indicates that customising the pace of the sessions to match the client's needs may enhance adherence. Additionally, it may be beneficial to emphasise and reinforce the strategies that are most effective for the client's cognition. Findings from the current research also provide a useful comparison between residential and outpatient settings. Previous research demonstrating effective use of group cognitive remediation approaches has predominantly occurred in inpatient settings (Marceau et al., 2017; Valls-Serrano et al., 2016). In these settings, clients stay at the location where the intervention is provided, which reduces the effort required to attend sessions and lowers the likelihood of forgetting to attend. Moreover, in a residential program, clients are expected to participate in various treatment formats throughout the day. The results of the present study suggest that the increased effort involved in remembering and attending a centre-based program may contribute to the reduced feasibility of a group format in an outpatient setting.

Conclusion

Based on the recruitment and retention rates, it appears that a group version of GMT in its current form is not feasible for this outpatient AUD population. Despite an attempt to use more naturalistic inclusion criteria than in previous studies, the results suggest that the eligibility criteria need to be even less stringent in subsequent iterations of the program to increase the number of participants. Participants generally provided positive feedback regarding the content within GMT, suggesting that the intervention itself may be acceptable for outpatient settings. However, retention rates and participant feedback from subsequent rounds suggest that a shortened or 1:1 format for GMT delivery has greater applicability for individuals with people with AUD in an outpatient clinic setting. Research with greater numbers is required to be able to statistically analyse neuropsychological data collected from participants.

Funding Open Access funding enabled and organized by CAUL and its Member Institutions

Declarations

Ethics Approval and Consent to Participate All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

Conflict of Interest The authors declare no competing interests.

References

Alfonso, J. P., Caracuel, A., Delgado-Pastor, L. C., & Verdejo-García, A. (2011). Combined goal management training and mindfulness meditation improve executive functions and decision-making performance in abstinent polysubstance abusers. *Drug and Alcohol Dependence, 117*(1), 78–81. https://doi.org/10.1016/j.drugalcdep.2010.12.025

Barkley, R. A. (2001). The executive functions and self-regulation: An evolutionary neuropsychological perspective. *Neuropsychology Review, 11*(1), 1–29. https://doi.org/10.1023/A:1009085417776

Bates, M. E., Bowden, S. C., & Barry, D. (2002). Neurocognitive impairment associated with alcohol use disorders: Implications for treatment. *Experimental and Clinical Psychopharmacology, 10*(3), 193–212. https://doi.org/10.1037//1064-1297.10.3.193

Bates, M. E., Pawlak, A. P., Tonigan, J. S., & Buckman, J. F. (2006). Cognitive impairment influences drinking outcome by altering therapeutic mechanisms of change. *Psychology of Addictive Behaviors : Journal of the Society of Psychologists in Addictive Behaviors, 20*(3), 241–253. https://doi.org/10.1037/0893-164X.20.3.241

Bonfiglio, N. S., Portoghese, I., Renati, R., Mascia, M. L., & Penna, M. P. (2022). Polysubstance use patterns among outpatients undergoing substance use disorder Treatment: A latent class analysis. *International Journal of Environmental Research and Public Health, 19*, 16759. https://doi.org/10.3390/ijerph192416759

Brorson, H. H., AjoArnevik, E., Rand-Hendriksen, K., & Duckert, F. (2013). Drop-out from addiction treatment: A systematic review of risk factors. *Clinical Psychology Review, 33*(8), 1010–1024. https://doi.org/10.1016/j.cpr.2013.07.007

Copersino, M. L., Schretlen, D. J., Fitzmaurice, G. M., Lukas, S. E., Faberman, J., Sokoloff, J., & Weiss, R. D. (2012). Effects of cognitive impairment on substance abuse treatment attendance: Predictive validation of a brief cognitive screening measure. *The American Journal of Drug and Alcohol Abuse, 38*(3), 246–250. https://doi.org/10.3109/00952990.2012.670866

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). Delis-Kaplan executive function system (D–KEFS). *APA PsycTests*. https://doi.org/10.1037/t15082-000

Domínguez-Salas, S., Díaz-Batanero, C., Lozano-Rojas, O. M., & Verdejo-García, A. (2016). Impact of general cognition and executive function deficits on addiction treatment outcomes: Systematic review and discussion of neurocognitive pathways. *Neuroscience and Biobehavioral Reviews, 71*, 772–801. https://doi.org/10.1016/j.neubiorev.2016.09.030

Fernandez-Serrano, M. J., Perez-Garcia, M., & Verdejo-Garcia, A. J. (2011). What are the specific vs. generalized effects of drugs of abuse on neuropsychological performance? *Neuroscience and Biobehavioral Reviews, 35*(3), 377–406. https://doi.org/10.1016/j.neubiorev.2010.04.008

García-Carretero, M. A., Novalbos-Ruiz, J. P., Robles-Martínez, M., Jordán-Quintero, M. A., & O'Ferrall-González, C. (2017). Psychopathological profile and prevalence of dual pathology on patients with alcoholic dependence undergoing outpatient treatment. *Actas Espanolas De Psiquiatria, 45*(1), 1–11.

Gooden, J. R., Cox, C. A., Petersen, V., Curtis, A., Manning, V., & Lubman, D. I. (2021). Characterisation of presentations to a community-based specialist addiction neuropsychology service: Cognitive profiles, diagnoses and comorbidities. *Drug and Alcohol Review, 40*(1), 83–92.

Harper, C. (1998). The neuropathology of alcohol-specific brain damage, or does alcohol damage the brain? *Journal of Neuropathology and Experimental Neurology, 57*(2), 101–110. https://doi.org/10.1097/00005072-199802000-00001

Harada, C. N., Love, M. C. N., & Triebel, K. L. (2013). Normal cognitive aging. *Clinics in geriatric medicine, 29*(4), 737–752.

Harper, C. (2007). The neurotoxicity of alcohol. *Human & Experimental Toxicology, 26*(3), 251–257. https://doi.org/10.1177/0960327107070499

Hayes, V., Demirkol, A., Ridley, N., Withall, A., & Draper, B. (2016). Alcohol-related cognitive impairment: Current trends and future perspectives. *Neurodegenerative Disease Management, 6*(6), 509–523.

Kedia, S., Sell, M. A., & Relyea, G. (2007). Mono- versus polydrug abuse patterns among publicly funded clients. *Substance Abuse Treatment, Prevention and Policy, 2*(1), 33–33. https://doi.org/10.1186/1747-597X-2-33

Kiluk, B. D., Nich, C., & Carroll, K. M. (2011). Relationship of cognitive function and the acquisition of coping skills in computer assisted treatment for substance use disorders. *Drug and Alcohol Dependence, 114*(2–3), 169–176.

Levine, B., Robertson, I. H., Clare, L., Carter, G., Hong, J., Wilson, B. A., Duncan, J., & Stuss, D. T. (2000). Rehabilitation of executive functioning: An experimental-clinical validation of goal management training. *Journal of the International Neuropsychological Society: JINS, 6*(3), 299–312. https://doi.org/10.1017/s1355617700633052

Levine, B., Stuss, D. T., Winocur, G., Binns, M. A., Fahy, L., Mandic, M., & Robertson, I. H. (2007). Cognitive rehabilitation in the elderly: Effects on strategic behavior in relation to goal management. *Journal of the International Neuropsychological Society, 13*(1), 143–152.

Lintzeris, N., Rivas, C., Monds, L. A., Leung, S., Withall, A., & Draper, B. (2016). Substance use, health status and service utilisation of older clients attending specialist drug and alcohol services. *Drug and Alcohol Review, 35*(2), 223–231.

Marceau, E. M., Berry, J., Lunn, J., Kelly, P. J., & Solowij, N. (2017). Cognitive remediation improves executive functions, self-regulation and quality of life in residents of a substance use disorder therapeutic community. *Drug and Alcohol Dependence, 178*, 150–158.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*(1), 49–100. https://doi.org/10.1006/cogp.1999.0734

Monds, L.A., Ridley, N.J., Logge, W., & Withall, A. (2021). Cognitive impairment. In Haber P.S.,, Riordan B.C., (Eds.). Guidelines for the treatment of alcohol problems (4th edition). Sydney: Specialty of Addiction Medicine, Faculty of Medicine and Health, The University of Sydney

Nasreddine, Z. S., Phillips, N. A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., Cummings, J. L., & Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society, 53*(4), 695–699. https://doi.org/10.1111/j.1532-5415.2005.53221.x

Perry, C. J. (2016). Cognitive decline and recovery in alcohol abuse. *Journal of Molecular Neuroscience, 60*(3), 383–389. https://doi.org/10.1007/s12031-016-0798-4

Randolph, C., Tierney, M. C., Mohr, E., & Chase, T. N. (1998). The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): Preliminary clinical validity. *Journal of Clinical and Experimental Neuropsychology, 20*(3), 310–319. https://doi.org/10.1076/jcen.20.3.310.823

Ridley, N., Batchelor, J., Draper, B., Demirkol, A., Lintzeris, N., & Withall, A. (2018). Cognitive screening in substance users: Diagnostic accuracies of the Mini-Mental State Examination, Addenbrooke's Cognitive Examination-Revised, and Montreal Cognitive Assessment. *Journal of Clinical and Experimental Neuropsychology, 40*(2), 107–122. https://doi.org/10.1080/13803395.2017.1316970

Robertson, I. H. (1996). *Goal management training: A clinical manual*. PsyConsult.

Robertson, I. H., Levine, B., & Manly, T. (2005). *Goal management training*. Baycrest Rotman Research Institute.

Shulman, M., Campbell, A., Pavlicova, M., Hu, M. C., Aharonovich, E., & Nunes, E. V. (2018). Cognitive functioning and treatment outcomes in a randomized controlled trial of internet-delivered drug and alcohol treatment. *American Journal on Addictions, 27*(6), 509–515. https://doi.org/10.1111/ajad.12769

Strauss, E., Sherman, E. M., & Spreen, O. (2006). *A compendium of neuropsychological tests: Administration, norms, and commentary* (3rd ed.). Oxford University Press.

Stamenova, V., & Levine, B. (2019). Effectiveness of goal management training® in improving executive functions: A meta-analysis. *Neuropsychological Rehabilitation, 29*(10), 1569–1599. https://doi.org/10.1080/09602011.2018.1438294

Suchy, Y. (2009). Executive functioning: Overview, assessment, and research issues for non-neuropsychologists. *Annals of Behavioral Medicine, 37*(2), 106–116. https://doi.org/10.1007/s12160-009-9097-4

Sullivan, A., Ridley, N., Monds, L. A., Logge, W., Hurzeler, T., & Morley, K. (2021). Assessing the validity of the Wechsler Adult Intelligence Scale (WAIS-IV) in predicting completion in a long-term residential rehabilitation for substance use problems. *Applied Neuropsychology: Adult*, 1–6

Sullivan, E. V., Rosenbloom, M. J., & Pfefferbaum, A. (2000). Pattern of motor and cognitive deficits in detoxified alcoholic men. *Alcoholism, Clinical and Experimental Research, 24*(5), 611–621. https://doi.org/10.1111/j.1530-0277.2000.tb02032.x

Valls-Serrano, C., Verdejo-García, A., & Caracuel, A. (2016). Planning deficits in polysubstance dependent users: Differential associations with severity of drug use and intelligence. *Drug and Alcohol Dependence, 162*, 72–78. https://doi.org/10.1016/j.drugalcdep.2016.02.027

Vik, P. W., Cellucci, T., Jarchow, A., & Hedt, J. (2004). Cognitive impairment in substance abuse. *Psychiatric Clinics of North America, 27*(1), 97–109. https://doi.org/10.1016/S0193-953X(03)00110-2

Wechsler, D. (2008). *Wechsler adult intelligence scale—Fourth edition (WAIS-IV)*. Pearson Clinical. https://doi.org/10.1037/t15169-000

Wechsler, D. (2011). *The test of premorbid function (TOPF)*. The Psychological Corporation.

World Health Organization. (2010). *International Statistical Classification of Diseases and Related Health Problems (10th Revision)*. World Health Organization.

Authors and Affiliations

Lauren A. Monds[1,2,3] · Amy Crowe[1] · Maria Bravo[1] · Nicole Ridley[1] · David Newcombe[4] · Rhys Mantell[5] · Nicholas Lintzeris[1,2] · Adrienne Withall[5]

1 Drug and Alcohol Services, South Eastern Sydney Local Health District (SESLHD), Sydney, Australia

2 Specialty of Addiction Medicine, Central Clinical School, The University of Sydney, Medical Foundation Building, 92 Parramatta Rd, Camperdown, Sydney, NSW 2010, Australia

3 Drug and Alcohol Services, Northern Sydney Local Health District, Sydney, Australia

4 School of Population Health, The University of Auckland, Auckland, New Zealand

5 School of Psychology, The University of New South Wales, Sydney, Australia